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Dear Kato:

The Xerox copies of your data sheets and charts arrived two weeks ago. Your letter, dated July 13, did not arrive, however, until a few days ago. It was much delayed in transit. I awaited this letter before sending comments to you on the charts and tables.

From the way in which you have organized the knob data and from the statements in your letter regarding this, I assume that you may not have agreed with the basic ideas that governed the discussions, mainly between Blumenschein and me, that took place during my last two visits in Mexico City (November, 1966 and July-August, 1969). Since you rarely participated in these discussions, I was not certain that you were interested in ~~topics~~ under consideration. These topics were concerned with our progress in detecting origins, migrations, introductions, and introgressions of races of maize as revealed by the constitution of the knobs that are present in the chromosomes. It ~~was~~ <sup>became</sup> evident that relationships could be uncovered by this means. The results that Blumenschein has obtained in his studies and his analyses of knob constitutions of races of maize grown in Venezuela, Brazil, Paraguay, Bolivia, and Argentina, have proved striking confirmation of the correctness of the premises upon which the knob studies were initiated. During our discussions in Mexico City tests of the validity of any one premise were undertaken, and with the data that were being organized at the time, either in table or map form. From such organizations it was possible to recognize the presence of distinctive knob complexes, to project their original locations, to follow their migrations and their introgressions as well as to recognize their

introductions into new geographic locations. Furthermore, it was possible to recognize specific routes of migration and introduction that had occurred in the past. You may recall that names were attached to some of these routes, such as the "Central Mesa Route", the "Venezuelan Route", <sup>and</sup> the complex but very well defined "Zapalote chico Route", etc. I have reviewed <sup>here</sup> the content of these discussions in order to emphasize what I have always considered to be the primary goals of the knob studies. The analyses that I have conducted with the knob data have always focused on these goals; and the results have served to confirm, supplement, and extend the conclusions of Wellhausen et al. ~~in the literature~~ (1952) on the origins and relationships of the races of maize. Because of the prominence of maize as an economic plant and because of its extraordinary and somewhat hidden history, attempts to elucidate its origins are of particular significance,--or so I believe.

I have some serious thoughts with regard to the manner of organization of the data that appears in your charts and tables. Although these charts and tables show some types of relationships they are unable to reveal why the results appear as they do within any one prearranged geographic boundary. The proportion of individual knob types that appear within any one bound area will depend, in many instances, on the number of plants of any one collection or of any one race that had been examined. For example, <sup>examined plants of</sup> if one had examined many plants of the race Cacahuacintle and few plants of the race Cónico, one conclusions might have been drawn from the charts and tables. Had the proportion of these two races been reversed, another results would have been obtained and another conclusion could have been drawn from it. Again, it is clear that the maize of the Kiowa and the Mescalero tribes of Oklahoma have knob constitutions that link this

maize closely with that of the Apache and Navajo tribes in Arizona and New Mexico. Maize from other tribes in Oklahoma, and in states to the north of Oklahoma, show similar linkage but this maize has been diluted to a much greater extent by introgressions with maize that was being grown in the North Central states of the U.S. From the chromosome constitutions of the sampled maize in all of these states, it is possible to reconstruct the types and locations of the knobs that were present in the maize of the North Central U.S. This maize appears to have had its origin either in the Central Mesa of Mexico or the Highlands of Guatemala.

There are some other illustrations that reflect the need for caution in lumping data according to a preselected geographic boundary. A good example would be that of the large knob in the long arm of chromosome 9 in Costa Rica. It is confined to a clearly defined area in North Central Costa Rica and it is present in <sup>plants of</sup> every examined collection within that area. Although it is present in Panama, it is not present in the examined collections from Nicaragua, nor in any other collection from Costa Rica. This is a revealing observation that lumped data would obscure. It should not be so lost. Rather, it should be recognized for its value, and the reasons for its singular distribution should be sought. Another example of this type is expressed in southern Bolivia and it involves the race Perola. This race is most singular for the area because it has all of the large knobs that characterize the "Venezuela-Southern Guatemala" complex. Obviously, it has been introduced into the area only, <sup>relatively</sup> recently. Some of its knobs have migrated into <sup>other races of</sup> maize in its vicinity but others have not. Lumped data for the area in which this race appears would not reveal the true source of the large knobs distributed within it. ~~Recognizing that~~

I am distrubed by another aspect of organization of your data. You give percentage figures for the frequency of occurrence of large, medium, and small knobs, as well as no knobs, at the particular locations in each of the chromosomes, ~~xxx~~ calculated from data of Longley and Kato. Because these data do not include the knob constitution of each homologue, a meaningful percentage figure for frequency of knob type may not be obtained from them. As calculated, some of the percentages may be close to accurate whereas others may be quite inaccurate. These data, nevertheless, do allow certain deductions to be drawn even though they do not permit accurate quantitation.

After receiving your tables and charts, I began to fill in blank maps of the Americans, both North and South, in order to illustrate where specific knobs are located, the ~~xxxxxxxxxxxx~~ distinctive patterns of distribution that are shown by the different knobs, the knobs that share the same patterns of distribution, and, when indicated, the particular race or races of maize that ~~xxxxxxxxxxx~~ have followed one specific migratory path. You may recall that this method of plotting the data was employed at our November 1966 meeting. Because this method makes it possible to reconstruct many facts relating to the past history of the races, it was the reason for all of the effort that you and Blumenschein put in last summer in constructing such maps ~~from~~ with the data obtained from the Mexican collections. I do not know in what way you have used these maps, but for me they have been invaluable. To illustrate this, I am enclosing a summary statement on the origin and distribution of knobs of medium size that I hastily put together to send to you. Some shift in emphasis may need to be made subsequently but this should not upset the general thesis as outlined in the statement. It is too strongly supported by the data.

I will conclude by stating that Blumenschein has used this<sup>2</sup> same method<sup>3</sup>

<sup>in</sup>  
~~for~~ analysing the sources of the maize races he has investigated.

As I stated earlier, he has been able to formulated some very definite conclusions, <sup>and these may be</sup> ~~that~~ <sup>dependent in the details</sup> are very well supported on the origins, migrations, introgressions, and introductions of maize in the areas of his studies. ✓

In this long letter, I have outlined in some detail my points-of-view, and why I hold them. I should be <sup>pleased</sup> ~~glad~~ to know your reaction to them. If you cannot agree that these points-of-view have value for you, I should be grateful to be so informed.

Sincerely yours,

Barbara McClintock.